Space Weather Technical Forecast

Issued on Saturday, 25 May 2024 at 12:21 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of M-flares throughout.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Moderate with peak flare M1.4 at 24/2025 UTC from AR3679 on the southwest limb. This region has now rotated on the far-side, leaving six numbered regions on the disc. The majority of these are simple and stable, with the main focus now on AR3691, a newly numbered region in the northwest. This is perhaps the lead portion of returning ex-AR3663 a very active region on the previous rotation, and it remains to be seen if further spots will follow. Due to the proximity to the limb, the region is difficult to assess, but is moderately sized and with some complexity, albeit appearing rather ragged.

No Earth-directed CMEs were observed.

Solar Wind / Geomagnetic Activity: Background to slightly elevated solar winds have been observed, perhaps due to a very slight enhancement from CH39/+, however this is low confidence. Solar wind speeds observed by ACE at L1 remained background to slightly elevated, 350-410km/s, with below average density. Interplanetary Magnetic Field (IMF), Bt, was mostly weak, but briefly Moderate 24/2145-25/0200 UTC, with peak 10nT. North-south component, Bz, remained weak between +8nT and -6nT, and most frequently positive (northward). The phi angle was initially positive (away from the Sun), but became more neutral after 24/2230 UTC, before trending slightly positive. Geomagnetic activity was Quiet (Kp 0-2).

Energetic Particles / Solar Radiation: High energy proton flux at GOES18 (greater than 10 MeV) remained at Background. High energy electron flux (greater than 2MeV) at GOES16 was background to moderate with a peak of near 225pfu. Associated 24-hour fluence remained below the Active threshold. Observed fluence at 25/0000 UTC was 1.21e7 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Isolated M-flares remain likely each day, perhaps from AR3679 over the limb day 1 (25 May), but with the main risk transferring to new sunspot AR3691 in the northeast. The return of hyperactive ex-AR3664 is also expected later in the period, maintaining this flare risk.

Solar Wind / Geomagnetic Activity: A weak CME glance is possible days 2-3 (26-27 May), although confidence is low. This is due to a filament eruption from the southeast disc on 23 May. Weak fast wind influences are possible, most likely day 3 (27 May) from the southern coronal hole CH40/+. Otherwise mainly background slow wind conditions are anticipated. Geomagnetic activity is forecast to be mainly Quiet, but perhaps increasing to Unsettled with a chance of Active intervals with any CME or fast wind arrival. There is a slight chance of a G1 Minor Storm interval.

Energetic Particles / Solar Radiation: High energy proton flux is expected to persist at background, with only a slight chance of enhancement. This most likely from AR3679, now over the limb, or if any activity occurs from the regions on the southwest disc, including AR3685. High energy electron flux is expected to persist at mainly background levels, with no notable enhancement. The associated 24 hour fluence is expected to remain well below Active.

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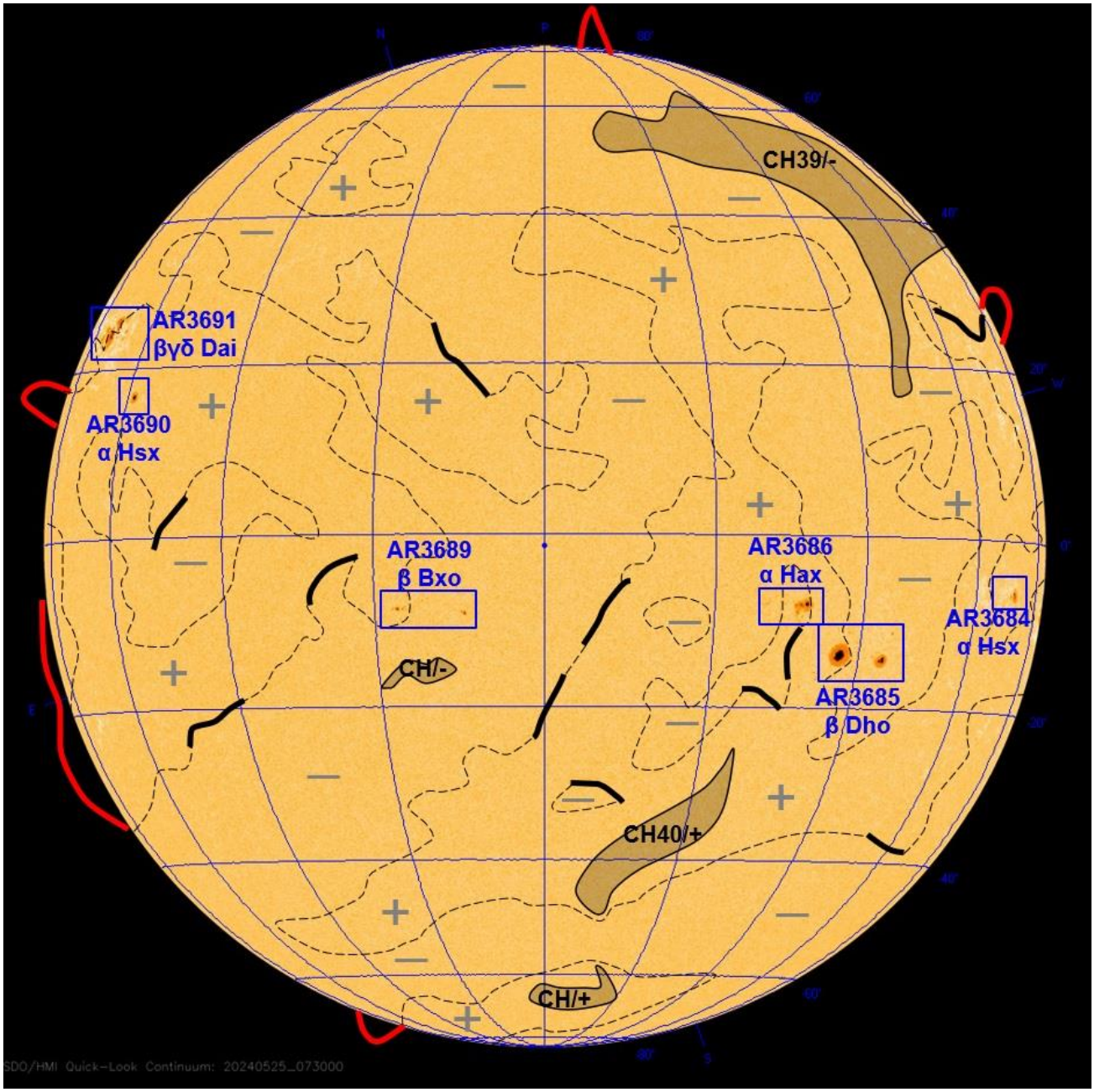
Figure 1. Solar Analysis Valid 25/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There is the potential for glancing impacts from a weak CME which left the Sun due to a filament eruption around 23/0600 UTC. This is low confidence, due to imagery being contaminated with non-Earth-directed CMEs, and due to its weak nature, however a weak arrival is indicated in MOSWOC Enlil late day or early day 3 (26-27 May).

Otherwise, the narrow southern lobe of CH39/- has either yet to be observed, or was the cause of a very slightly increase late 24-25 May. Either way, this feature looks increasingly unlikely to cause any notable effects at Earth. CH40/+ is also present as a southern disc feature, perhaps also bringing a slight enhancement to the solar wind on day 3 (27 May), however this is also unlikely to bring a notable connection due to its southern latitude location.

Subsequently mainly background solar wind speeds are forecast, perhaps rising to slightly elevated with either enhancement. Geomagnetic activity is also expected to persist mainly Quiet, but perhaps rising to Unsettled with Active intervals with any coronal hole or CME enhancement. There is only a slight chance of isolated G1 Minor Storm intervals.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	5	5	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
24/1225	Partial	Filament Eruption	SE	320 km/s	27/0000 +/- 12 hrs	Low confidence. Glancing.

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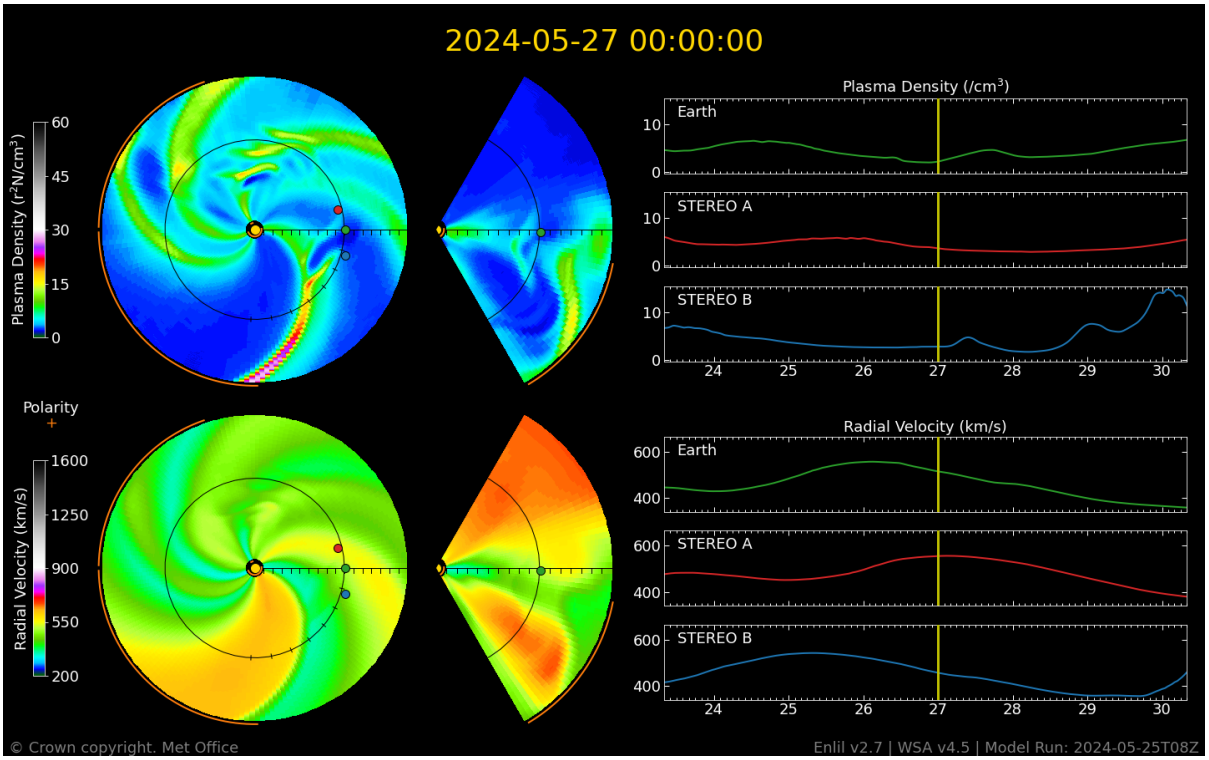
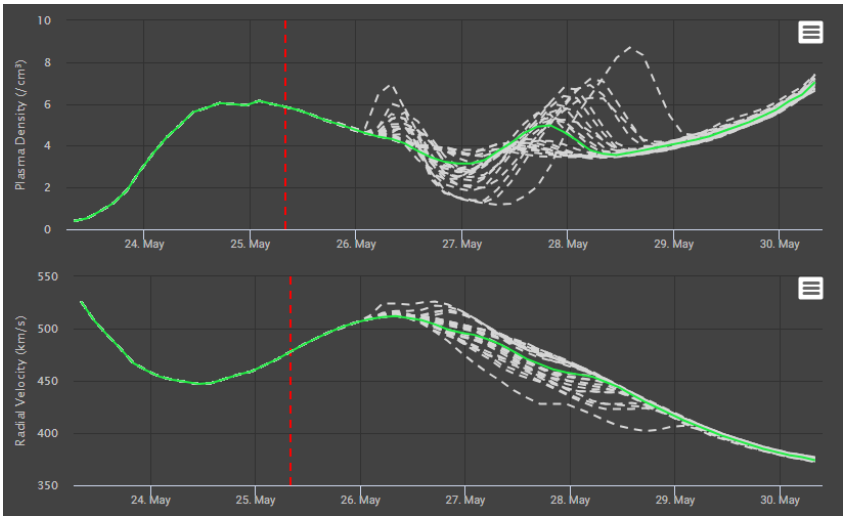
Figure 2: Enlil + Ensemble. Background winds are too fast, with arrival most likely around midnight on 27th. Any arrival is likely to be weak.





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Radio Blackouts - X-Ray Flares:

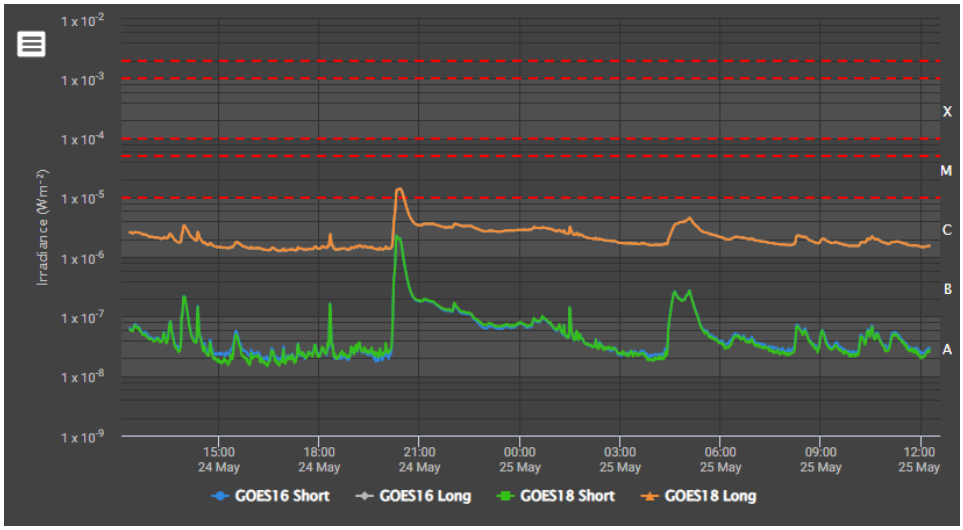
Moderate to Low activity is expected to continue, with the chance of isolated M-flares, predominately from AR3691 in the northeast, and any subsequent regions also expected to rotate onto the disc.

There are six numbered sunspot regions on the visible disc, with AR3679 now rotated on to the far-side. Aside from AR3691 all these regions are either simple and stable or decaying. This includes three region in the southwest, of which AR3685 is the largest. In the northeast, AR3691 is likely from the lead portion of ex-AR3663, an active region from the last rotation that produced five X-class flares. This has returned as a ragged and small region, set within plage, but does still exhibit some complexity. This includes a small potential delta configuration within its northern most penumbra along with some other mixed polarity areas, although these are hard to be confident in due the foreshortening effect in magnetic imagery for its near limb location. The magnetic looping evident over the spot also extends further east, perhaps suggestive of further spots to rotate on.

Hyperactive ex-AR3664 is also expected to return the southeast limb. This produced 11 X-flares, including the strongest of SC25 so far (X8.7), however it remains uncertain how much of this spot remains, as it has likely matured through its travels across the far-side. Despite this, a chance of activity persisting is maintained, with flares potentially observable a day or two before its likely return on day 3 (27 May).

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	Yes	50	50	50	50
Very Active	R3 to R5 X Class	No	5	5	10	10

Figure 3: GOES 16/18 X-ray flux



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Solar Radiation Storms - (High Energy Protons):

GOES-18 proton flux is currently at background, and expected to persist at these levels through the period. AR3679 is just over the southwest limb, on the far-side, with a decreasing chance of producing Earth-directed proton events. AR3685 is another modestly sized region in the southwest disc, however this appears to be on a declining trend. This leads to only a slight chance of the proton flux rising in response to any notable flare activity.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

GOES-16 electron flux continues to vary diurnally from Background to Moderate. The enhancement from CH39 appears to have been minimal, with little connection to Earth, and there is only a slight chance of a weak connection to CH40/+ by day 3 (27 May). Furthermore, there is the potential for a weak CME glance, which may aid to further suppress the electron population at GEO. This is most likely to result in flux declining to persistent background levels.

The associated 24 hour electron fluence is expected to remain below the Active level, as supported by MOSWOC REFM, which is currently providing good guidance for the expected trend.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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